THE FUTURE OF GEOTHERMAL ENERGY IN INDONESIA'S ELECTRICITY SECTOR

Ir. Eddie Widiono S, M.Sc.

A. Introduction

One of the renewable energy resources is the geothermal energy and this kind of energy is of abundance in Indonesia which has chains of volcanoes along the southern belt as well as at the northern part of the archipelago. The known sites/locations of this resources may take place nearby people dwellings like at Kamojang in West Java and Lahendong in North Sulawesi or remote from the people dwellings or develop areas like many sites in the Eastern part of Indonesia.

Until March 2001, PLN's total geothermal capacity is 360 MW, comprises of :

- Kamojang (West Java) : 140 MW (3 unit)
- Darajat (West Java) : 55 MW (1 unit)
- Gunung Salak (West Java) : 165 MW (3 unit)

The newest palnt at Lahendong (North Sulawesi) will be opearted commercially on April 2001 with total capacity of 20 MW.

Independent Power Producers (IPP) have added 395 MW of new capacities from :

- Dieng (Central Java) : 60 MW (1 unit)
- Darajat (West Java) : 60 MW (1 unit)
- Wayang Windu (West Java) : 110 MW (1 unit)
- Salak (West Java) : 165 MW (3 unit)

Although the above data shows that Indonesia is among a few conutries in the world that developed geothermal plants (others are New Zealand, Philipine and USA), the future of geothermal energy is not secure yet. Further development is hampered by the fact of relatively high cost of development and large amount of investment.

With a commercial basis financing scheme as present, the energy selling proce of geothermal palnt does not macth the affordability of current retail tariff. This problem is exacerbated further by GOI plan to restructuted its power sector and introduce competition on generation as well as retail sub sector. The future of Geothermal Plant will depend upon its competitiveness againts other electricity generation and therefore it requires a clear policy direction and support from GOI.

B. Overview

Total installed generating capacity of PLN is 20.592 MW, while the geothermal generating capacity is 360 MW

Table 1 – Installed capacity of Generating Plants

Power Plant Types	Outside Java-Bali	Java-Bali	Total
Hydro	586	2374	2960
Combined Cycle			
- Gas Fired	860	3786	4646
- Oil Fired	-	1707	1707
Steam			
- Gas Fired	-	1000	1000
- Oil Fired	310	750	1060
- Coal	460	4200	4660
Geothermal	-	360	360
Gas Turbine	520	1434	1954
Diesel	2153	92	2245

If we focused on Java-Bali, the production of each type of generating plants are as indicated in Table 2 – Generation Production Mix of Java-Bali system

Table 2 – Generation Production Mix of Java-Bali System (GWh)

Power Plant Types	Java-Bali	%
Hydro	6310	9.47
Combine Cycle	22290	33.46
Steam	34778	52.21
Geothermal	2648	3.98
Gas Turbine	486	0.73
Diesel	103	0.15

or 1.75% of total. The detail of generating cacapcity can be seen on the Table 1 below

Eventhough the installed cacapcity of geothermal generation is only 1.75% but its energy production takes 3.985 share of total energy production of 66 TWh. This indicates that under merit order system currently being implemented in Java-Bali, Geothermal Plants have enjoyed Capacity factor, this is due to the following factors:

1. Dispatcher considers Geothermal palnts as a "must run unit", since high availability and low O&M costs of geothermal plants, making them suitable for base loader.
2. Unit sizes relatively small and geothermal plants are not too favourable to perform as swing generators.
3. Pressure of Take or Pay clause (either from steam supply contract or electricity generation contact).

The cost of electricity produced by Geothermal Plant are currently vary between Rp. 89.60 - Rp. 451/kWh (PLN owned PP), 4.2 centslkWh (negotiated IPP), and as high as 7.15 cents/kWh (negotiating IPP, 30 years). The high cost of electricity from Geothermal Plant can be traced to several factor e.g :

1. High project cost, which can be estimated to range between 1600 USD to 2000 USD/kWh. The result is average Capacity Payment of range 2.2 to 3 USD/kWh.
2. High Energy Component, which in many cases, resulted from base energy proce of figure in the range of 4-5 USD/kWh, plus premium on risk and insurances (including force majure) and escalation linked to US CPI.

It is obviuos that the above cost does not macth the present Electricity Base Tariff (EBT), and even its energy component cost (variable charge) cannot compete againts average total cost of high speed diesel generation of industrial consumers.

around 13.519 MW by captive power for their own need. PLN as State Owned Enterprise serves around 27.5 million customers which represents electrification ratio 0f 55%.

In 1998 when economic and monetery crisis hit the country the electricity demand in Indonesia grew only 1.5% in contrast with 15% growth previously when the country economy was sound. In 1999 this growth became 9% and in 2000 the growth was 12%. Based on the forecast of 6% pa GDP average growth, electricity demand growth is forecasted to be 10% pa on the average, such that in 2005 the expected PLN energy sale is projected to be 117.599 GWh increasing 40.390 GWh or 52.30% from that 2000. PLN will need annual additional cacapcity of 1000 MW. This trend of moderately strong growth will burden the GoI with a huge investment budget, and provide opprtunity for private investors to participate, either in the IPP format or startegic partnership with PLN.

Another problem in electricity sector development is the low

Table 3 – Comparisons of Plants Capacity Factor, Java-Bali System, typical

Types of Plant	CF (%)
Coal fired Steam PP	73
Gas fired SPP	56
Oil fired SPP	46
Gas Fired CCGT	64
Geothermal PP	88
Hydro PP	36

C. The Restructurcted Indonesian Power Sector

Current Conditions

The installed capacity of electricity suplly in Indonesia at present is around 35.709 MW, the largest slinec of around 20.592 MW is generated by PLN (State Power Company), while the rest about 1.600 MW by IPP, and

affordability of the people which has formed a constraint in the tariff adjustment, however, in 2000 PLN has successfully implement tariff increase of 56% dan 76% to industrial and business consumers and bring the average tariff increase which aimed to reach average tariff of 7 cents/kWh by 2005.

In addition since 1998 the policy of decentralization of power was come

into play leading to the birth of Autonomy Law which is to be implemented in early 2001. Autonomy Law allows the regional government to exercise control over the development of electricity infrastructure in its region leaving the Central Government to control over National Grid and Big Power Plant that serves more than one region.

Power Sector Restructuring

To respond effectively to the current condition and to maximize the longer-term development of the power sector, in August 1998 the Government of Indonesia (GoI) has decided to launch a new power sector restructuring program known as ***The policy Paper***. The GoI's long term vision for the power sector has three central element namely (1) The GoI needs a power sector which grows rapidly as such to be able to provide universal coverage for Indonesian household and to support industrial and commercial growth across the country, (2) The GoI desires of a world class power sector which is able to provide high quality, reliable service with increasing levels of efficiency, thereby benefiting consumers and promoting the global competitiveness of the Indonesian economy, and (3) The GoI expects the power sector to become financially independent and self reliant

By the issuance of The Policy Paper, there will be no vertical integration business. To assure new entrants of a level playing field, PLN as the holder of electricity authority will be unbundled into many companies which each of the, has only single function in electricity business. As Java-bali area seems to be more ready for competiton, the first stage of sector restructuring is to create separate players for each Transmission, Generation, and Distribution side while the electricity business Outside Java-Bali will be managed by a Regional Electricity Company.

The GoI adopted foru restructuring objectives namely : restoring finacial viability, competition, tranparency, and more efficient private sector participation. Furthermore, the GoI has identified six key area of activity where work will be required to achieve the restructuring objectives and these relate to : (1) industry structure and the unbundling of the electricity supply industry; (2) the development of commercial relation and the introduction od competition; (3) new method of tariff setting and management of subsidies; (40 the rationalization and expansion of private sector participation; (5) the redefinition and clarification of government roles and strengthening of the regulatory function; (6) the development of new legal framework.

On the other hand The GoI has made a policy in empowering the provincial government as an autonomy body as well as a policy to balance the income ratio between central and regional governments. The Draft of the New Electricity Law has also considered those policies by dividing the electricity market into Competitiveness areas where in the Non Competitive area the business will be regulated by the Head of the Regional Government.

PLN's Implementation

Before new legal framework is implemented by Government and with considering the company's internal condition, PLN has conducted three strategic actions in preparation to face the electricity competitive market namely: (1) internal consolidation (corporate restructuring, financial restructuring, speeding up the renegotiation of PPA's and empowerment of human resources); (2) profitization (enhacing efficiency drive program of both opex and capex terms, communicating PLN's operation expenditure to Government, Legislative, and customers to gain support on tariff up-lifting to viable economic price level); (3) provatization (encouraging the Subsidiaries going ti IPO and establishing cooperation between them and the domestic strategic partners which include among others regional state enterprises as well as international strategic partner).

To anticipate to the government policy changes, PLN's action is to prepare all operational units to be ready to do business by their own. Coordination with regional authority for local funding, other opportunities such as strategic partnership and changes in tariff schemes should be taken by Unit's managers. In this condition operational unit will be treated as SBUs.

Electricity Trading Mechanism Migration Going To Power Restructuring (see Appendix),

- Currently no competition at all levels, customers have no choices and Government makes decision;
- Internal Competition (started in 2000 and conducted in Java-Bali system) implementing generator competition (plant by plant contract basis);
- Single Buyer Market (after New Electricity Law enacted by Government) implementing generating companies competition, single buyer has choice, and implementing market price tariff.
- Wholesale Competition (after New Electricity Law enacted by Government) where high voltage customers, Distribution and Retail companies have choices;
- Multi Buyer and Multi Seller : Retail Competition implementation where retail and Consumers both have choices.

Electricity competition will begin in Java-Bali system, which constitutes 80% of Indonesia electricity market and where the system is well developed. Whereas outside Java-Bali system conditions dictate a more gradual move to competition. The implementation of the competitive market in Indonesia is expected to go on stream by 2007.

D. Developing the Geothermal Energy Resources

There are two ways of harness-

ing the geothermal resources namely :

a. Direct application or use, generally the steam is used for processing usage or harnessed as a hot-water swimming pool condition that the temperature in not too high and casily explored.
b. The geothermal energy is conevrted as electric energy. This conversion is developed from resources which are feasible to be constructed as electric power plant.

In the first place a geothermal resources should be explored and a drilling shall be undertaken to get a proof/ evident that the resources is worth developing as an energy resource or not. When it comes to the conclusion that the well is not worth developing then the drilling cost risk has to be borne by the explorer. This is one of the risk that should be calculated when geothermal resource is to be developed.

In addition, geothermal resources generally locate in a remote area which is not well developed with minimum infrastructure and facilities, sometimes in a mountainous area. To start the exploration it is sometimes needed to construct the costly infrastructure to have access for the supplies and equipments.

The Government of Indonesia has striven to support the dvelopment of geothermel resources by giving ways to lessen the amount of the above mentioned risk and this is written in the Presidential Decree No. 76/2000 on Geothermal Resource Exploration for Electric Generating Purposes among ohers in Para II, Section 2, point (1) and (2) :

1. Exploration activities (geological-, geochemical), geophysical-researchs and temperature allevation which when integrated in an geothermal area is able to produce steam of fluid through an exploration well aiming to get information on expected resource, possible resource and proven resource) then the exploration may be undertaken by government cooperative or private entities.
2. Exploration of Geothermal resources (production well drilling and injection to reach production capacity target, geothermal field facilities construction for electric energy generation) by the government are based on geothermal prospect and electric power demand.

From item (1) above it can be seen that the GoI bears the risk of the failures of exploration when it fails to find a well of enough potential to be developed further an on item (2) indicates that exploration activities by GoI are aim at fulfilling the electric power demand.

Table 4 – ESC Contracts of Geothermal

Geothermal Plant	Location	Year (step price)	Selling price (cent USD/kWh)
PLTP Bedugul	Bali		7.15
PLTP Cibuni	West Java		6.90
PLTP Darajat	West Java		6.95
PLTP Dieng	Central Java	1 – 14	9.81
		15 – 22	7.41
		23 – 30	6.21
PLTP Kamojang	West Java		7.03
PLTP Karaha	West Java	1 – 14	8.46
		15 – 22	6.57
		23 – 30	5.63
PLTP Patuha	West java	1 – 14	7.25
		15 – 22	5.63
		23 – 30	4.82
PLTP Salak 4,5,6 (BOT)	West Java	1 – 14	8.46
		15 – 30	4.94
PLTP Sibayak	Sumatera		7.1
PLTP Wayang Windu	West Java	1 – 14	8.39
		15 – 22	6.51
		23 – 30	5.51

Electricity selling price from geothermal resources

As a comparison of selling price from geothermal plants developed by IPPP it can be seen from the following Table4 :

Energy Type	Confirmed Reserve	Reserve as equiv. MW	Exploited as PLN Elect. MW	% Exploited to reserve
Coal*)	5.2 Billion Ton	50.700	5.000	9.9
Gas*)	114.2 TSCF	68.800	4.500	6.6
Oil*)	5.58 Billion bbl	12.700	8.000	63.0
Hydro	5.000 MW	5.000	3.000	60.0
Geothermal	20.000 MW	20.000	550	2.8

*) Reserved equiv. MW is equal to energy demand for 25 years generation

From the Table 3 above it is clearly seen that there is an incompatibility or controversy between the electricity selling price of PLN and the selling price of the government produced electricity. The question is something wrong exists either in PLN selling price geothermal selling price?

Future PLN Energy Mix Policy

Basic principal : Least cost to PLN, price as a determining factor to energy mix scheme with fixed National Energy Availability consideration.

Enhancing Competitiveness

Enhanching the comnpetitiveness of Geothermal Energy, reqiures a careful study toward three (3) different aspect i.e:

1. Who should be the beneficiaries of geothermal energy development
2. Factor that push the cost up and reduce competitiveness
3. How to create a stronger relations between Geothermal Energy investors and the consumers

The geothermal energy has some advantages compare to other resources. The general characteristics of geothermal energy are :

- Renewable, environmetal friendly Geothermal resources, if properly exploited, technically will neverlast. Its existence reqiures environment balance to be maintain
- Non exportable, non tradeable in its form, therefore independent from world energy price
  As a local resource geothermal energy is really independent from world energty fluctuation
- Good for Base Loader in Electricity System

Wee need to develop the above characteristic of geothermal energy for its competitiveness againts other enerrgy in electricity generation.

Because it is renewable and environmental friendly, development of geothermal energy need to be supported by global environmental fund. Initiatives under Kyoto Protocol should be develop such that Carbon Emmision trading can be one of the source to finance development of Geothermal Energy. Step are currently taken to increase the awareness of all relevant parties especially government agencies, before finally set to allow this to be happened.

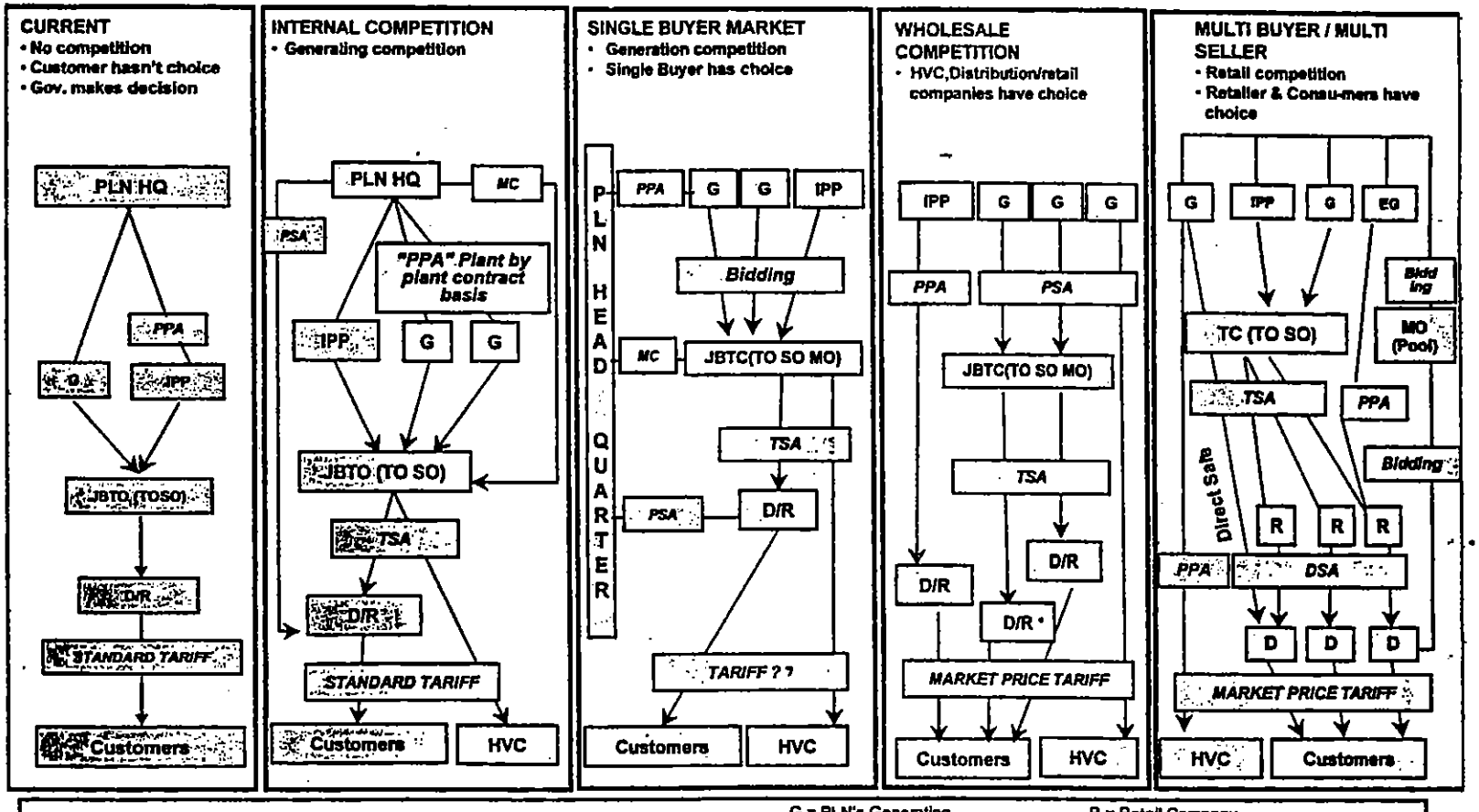
Consistent with international initiatives, there should be domestic rewards for the development of geothermal energy. Currently the Presidential Decree No. 76/2000 provide such incentives to the resource exploration effort by mechanism that allows GoI to take over exploration risk from licensed developer. Other taxation and royalties shall be aligned to provide further domestic incentives.

Although it is suggested that development of Geothermal Energy shall be rewaded with the above facilities, its energy sales agreement shall be equal to other forms of energy competing in electricity market. The risk factor shall be addressed in equality between seller and buyer.

The Geothermal energy is a local energy, therefore all effort should be done to keep it local, at least there should be a significant portion of its cost which is free from forex risk. If it can be arranged that way, than the benefit of this local energy should mostly be to them who utilizes electricity for export commodities. Which in turn translate this benefit toward a competitiveness of its product in the global market. PLN through commercial arrangement are now able to provide links between producers and consumers. One of the best candidate for the consumers are Textile and Chemical industries which mostly are the Base-load of electricity system.

Ir. Eddie Widiono S, M.Sc.,Saat ini Direktur Utama PT. PLN (Persero)
Disampaikan dalam Annual Scientific Conference & Exhibition, 5th Indonesian Geothermal Association, Yogyakarta, 7-10 Maret 2001

ELECTRICITY TRADING MECHANISM MIGRATION GOING TO POWER SECTOR RESTRUCTURING



*) = Market Price Tariff or Standard Tariff ?

TO = Trasmission Owner
SO = System Operator
MO = Market operator
MC = Management contract

PSA = Power Sales Agreement
TSA = Transmission Services Agreement
DSA = Distribution Services Agreement
T = TRANSCO
EG = Embeded Generating

G = PLN's Generating
IPP = Independent Power Producer
D/R = PLN's Distribution Retail
PPA = Power Purchase Agreement
HVC = High Voltage Customer

R = Retail Company
D = Distribution Wire Company
JBTO = Java-Bali Transmission & System Operation (SBU)
JBTC = Java-Bali Transmission Company
TC = Transmission Company